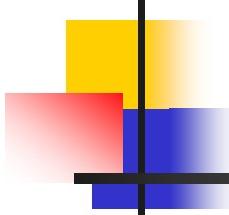


Mutual Ground

Rick Alterman
Computer Science Department &
Volen Center for Complex System
Brandeis University

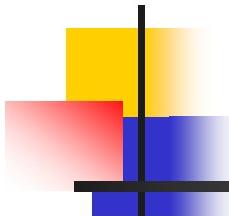
This work is sponsored in part by ONR - N00014-02-1-0131

Report Documentation Page			Form Approved OMB No. 0704-0188	
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1. REPORT DATE JAN 2005	2. REPORT TYPE	3. DATES COVERED 00-00-2005 to 00-00-2005		
4. TITLE AND SUBTITLE Mutual Ground		5a. CONTRACT NUMBER		
		5b. GRANT NUMBER		
		5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)		5d. PROJECT NUMBER		
		5e. TASK NUMBER		
		5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Brandeis University, Computer Science Department & Volen Center for Complex System, 415 South St, Waltham, MA, 02453		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)		
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited				
13. SUPPLEMENTARY NOTES Collaboration and Knowledge Management (CKM) Workshop, 11-13 Jan 2005, San Diego, CA. U.S. Government or Federal Rights License				
14. ABSTRACT				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 37
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	19a. NAME OF RESPONSIBLE PERSON	



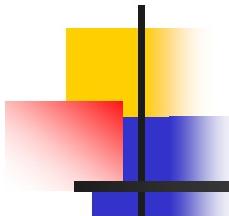
Intersubjectivity

- What we “mentally share” about the world
 - Sense of reality
 - Meaning
 - Framework for coordinated activity
 - Includes cultural basis for behavior
- Size of interactive space can vary



Three Elements

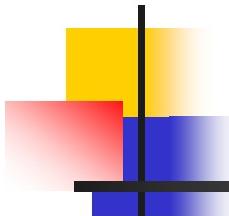
- Biology
 - Visual apparatus
- Representation
 - Internal (prior knowledge)
 - External (artifacts that mediate)
- Interaction
 - organization of exchanges



Dynamics

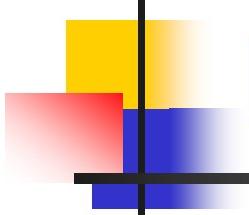
- Idiosyncratic and historical character
 - the physical environment
 - the actors
 - the prior experiences of the actors are different
- Design of task environments also changing.
- Account for
 - the difference between,
 - the change among,
 - the “sameness” of,

Similar types of encounters



Model

- The Equivalence of Internal Representations
- Interaction and Common Ground
- Mutual Ground
- Accumulation
 - Conversational Structure
 - Coordinating Representations
 - Cycle
- Cognition

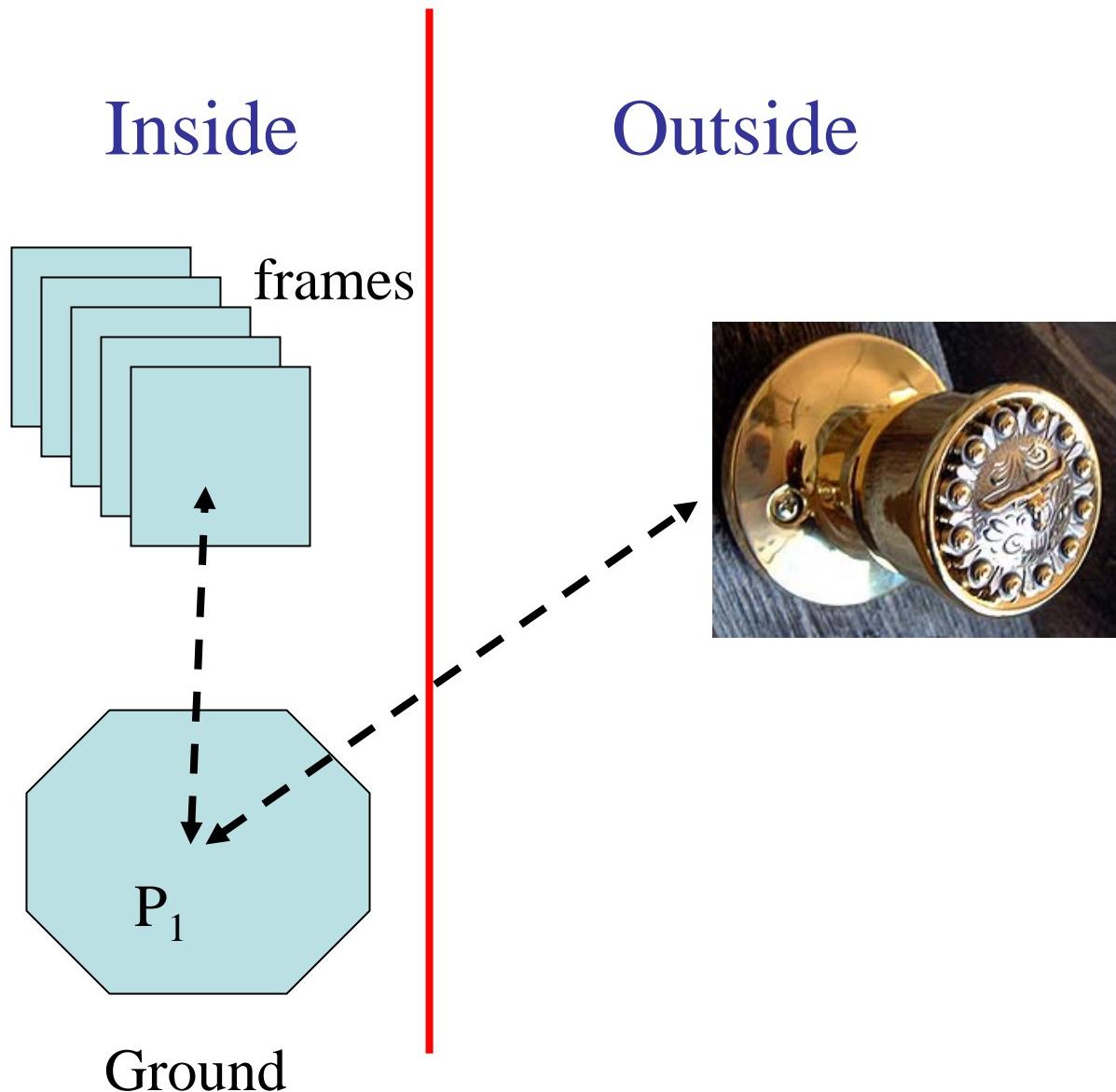


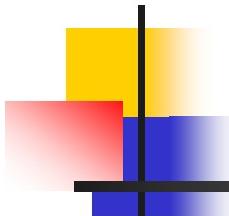
Equivalence of Mental Representations

- Does a shared intersubjective space mean identical/intersecting mental representations of the situation at hand?

Opening a Door

- The doorknob (external object)
- The frame the predicts the doorknob (knowledge)
- The grounding of the doorknob slot



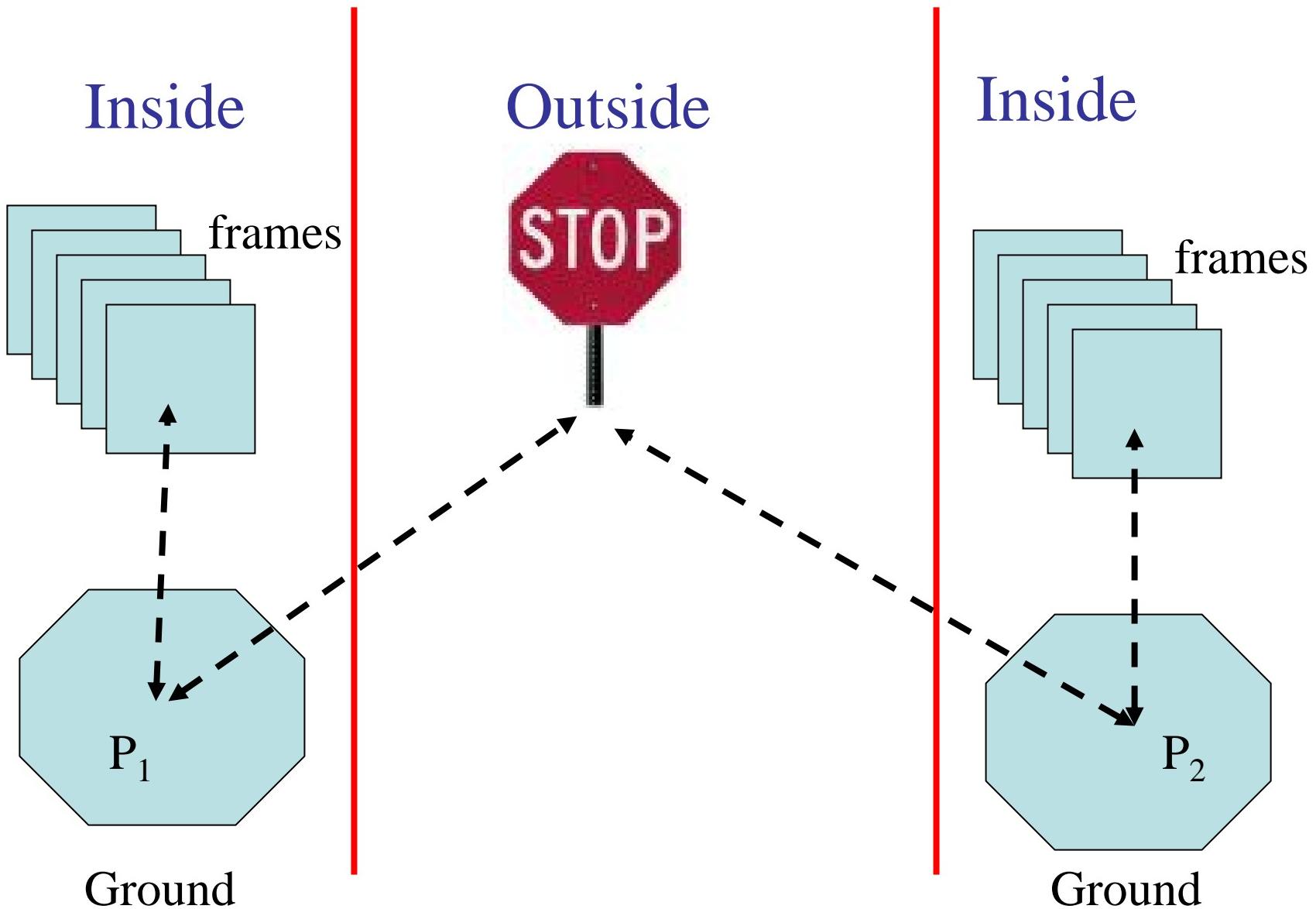


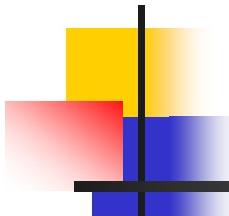
The Stop Sign

- Individual knowledge of stop signs
 - Rules of about stopping (DMV)
 - Meta knowledge about conventions for acting when stop signs are at the scene of the activity
- Knowledge about the types of participants and expectations of how they might act
- Road conditions, how heavy traffic is, time constraints
- Only a selection of this knowledge is grounded by each individual



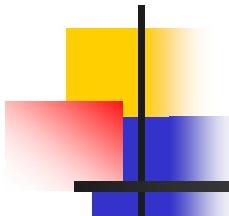
What is shared?





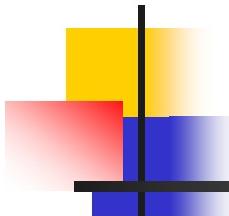
Representations are functionally equivalent

- Does a shared intersubjective space mean identical/ intersecting mental representations of the situation at hand?
 - No
- From the point of view of an outside observer, one could claim that their ground functioned as if both actors ground the predicate that one of them would go first



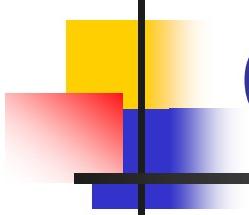
Interaction not representation

- Instead, what seemed programmatically promising was a *procedural* sense of “common” or “shared,” a set of practices by which actions and stances could be composed in a fashion which displayed grounding in, and orientation to, “knowledge held in common” – knowledge that might thereby be reconfirmed, modified, expanded and so on. (Schegloff, 1993: p. 1298)



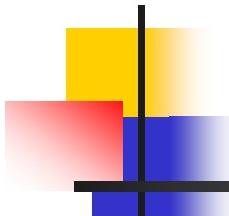
Conversational Analysis

- Organization of the interaction
 - Display understanding of situation-at-hand
 - Recognize and repair breakdowns in intersubjectivity
- Conversation
 - Sequential
 - Interactants take turns
 - First position: speaker presents contribution
 - Second position: other participants have opportunity to display response
 - Third position: initial speaker can amend her presentation if it did not invoke a preferred response



Clark's Common Ground Criteria

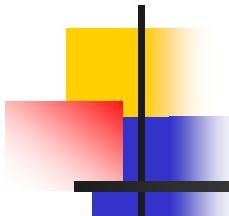
- For two people A and B,
it is common ground that p iff;
 - A and B have information that some basis b holds;
 - b indicates to A and B that A and B have information that b holds;
 - b indicates to A and B that p.



Has problem of equivalence of representations disappeared?

- Does not seem necessary that A and B have grounded the exact same P
 - A believes P_1
 - B believes P_2
 - P_1 and P_2 are at best some epsilon away from each other
- Ditto for the basis b

Functioning of mental representations



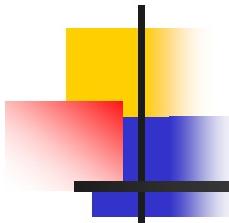
Mutual Ground

A and B are acting.

- If A's behavior is mediated by some internal frame F_i .
 - Normally achieves his goal
 - Consistent/grounded with action of B up to that point
- Then A believes that he can use F_i to continue the interaction.

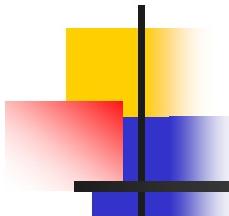
If B's actions do not fit into the frame that mediates A's behavior

- either a new frame is selected by A to internally mediate his behavior,
- or a meta-process to align private representations of shared activities is invoked.



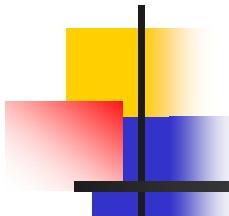
Breakdown

- A and B have internal frames that are not aligned and a breakdown occurs, i.e.,
 - Either
 - A's internal mediator F_i cannot ground B's behavior in the frame that achieves A's goal and explains B's behavior.
 - Or
 - B's internal mediator F_j cannot ground A's behavior in the frame that achieves B's goal and explains B's behavior.



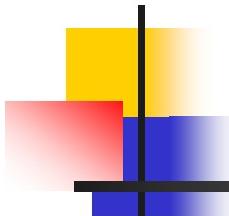
Breakdown & Meta-Interaction

- A breakdown occurs and there is a communicative interaction
 - This is a *meta-interaction*.
- Since A and B can never directly compare their internal representations of the situation, this meta-interaction is essentially a pointing game.
 - One actor makes a presentation and the other actor either accepts the presentation or indicates that further clarification is needed.



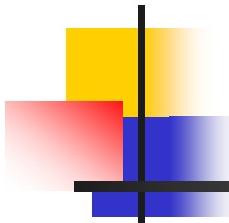
Mutual Grounding

- A makes a presentation
 - Presentation points to what A believes is a commonly known organization of behavior that achieves A's goal and that A believes B will agree to participate in.
- B accepts A's frame if
 - B can find an internal mediator F_j that achieves B's goal and grounds A's behavior.
- Mutual Ground Criteria
 1. A's presentation is grounded by A to indicate frame F_i and by B to indicate F_j
 2. A believes F_i will lead to the achievement of A's goal and it accounts for B's behavior
 3. B believes F_j will lead to the achievement of B's goal and it accounts for A's behavior



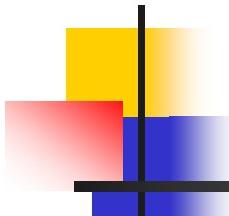
Common Ground Versus Mutual Ground

- Every case of mutual ground is a case of common ground but not vice versa
- Deception can be explained in terms of mutual ground
- Difference in recall of prior events can be explained by mutual ground not common ground
- Expert and novice interaction
- The mental sharing of collaborating actors with different roles
- When one participant is bored or not interested in arguing, progress in the interaction



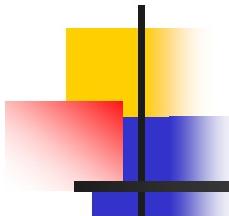
Model

- The Equivalence of Internal Representations
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- Mutual Ground
- Accumulation
 - Conversational Structure
 - Coordinating Representations
 - Cycle
- Cognition



Accumulation

- Reduction in the amount of collaborative work in recurrent activities
- Debugging
- Functional distance between individual representations of the recurrent activity decreases.
- Mediate the interaction
 - conversational structure that organizes the meta-interactions within the team.
 - pre-design the team's task environment



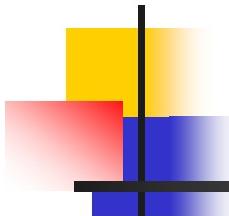
Recurrent activities produce conversational structure

- Invention of conversation structure
 - First form of social accumulation
 - Flexible

Telephone Conversation
(Core Opening Sequence)

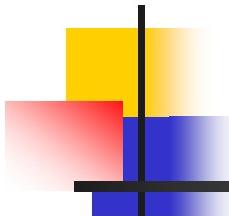
1. The summons/answer sequence
2. The identification (and/or recognition) sequence
3. Greetings
 - Ratified mutual participation
4. 'How are you'

(Schegloff 1986)



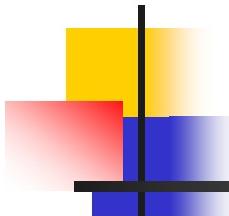
Mutual Ground and Conversational Structure

- Suppose Simone wants to call her lover Jean Paul on the phone to let him know her flight has been cancelled:
 - F_i
Her plan to inform Jean Paul that her flight is canceled
 - $C_O S_i$
Her internal representation of the core opening sequence



Re-design the Task Environment

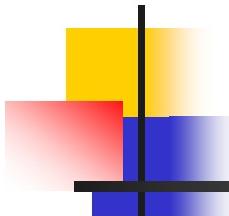
- Invention of conversation structure is not always ideal
- Embed in task environment some preferences for organizing recurrent behaviors
 - Pre-computes some of runtime work of actors (Norman, 1991)
 - Enables distribution of work



Coordinating Representation

External representation available at the scene of the activity prior to the current activity that was designed to “solve” a problem in aligning private view of shared activity

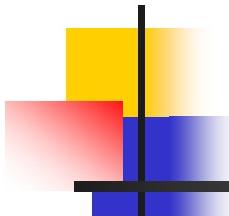
- Stop sign
- Clock
- Appointment slip
- Airport
- Mail order catalogue
- Words/Signs



Coordinating Representation

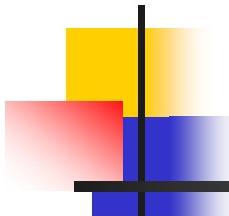
(continued)

- All artifacts can be used to mediate the co-construction of a shared understanding, but not all artifacts are designed to do that
- Not all external representations are intended to mediate an interaction between actors
 - Personal diary
 - Scratch sheet that is used to do arithmetic calculations
 - Earlier drafts of this talk



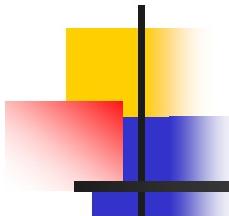
Mutual Ground and Coordinating Representations

- Suppose A performs an action/presentation/display p during an interval of cooperation with B who has goal G
 - B's behavior is mediated by coordinating representation C that B has grounded using F_j
- B will invoke a meta-interaction if
 - B cannot ground p in a manner consistent with F_jOr
 - B cannot find an alternate frame F_k that grounds G, C, p , and the prior actions of A during the current interval of action



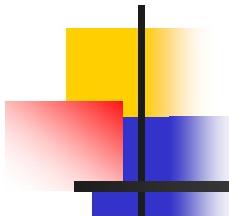
Cycle

- As a group begins to collaborate, they settle into a routine
 - They make choices about how to represent and reason about various aspects of the task
- Design of task environment is never a fixed point
 - Recurrent breakdowns
 - Better ideas, new technologies, attitudes, trends, styles
- Changes to task environment (new CR's) ⇒
Changes to interaction ⇒
New conversational structures



The vocabulary of the interaction

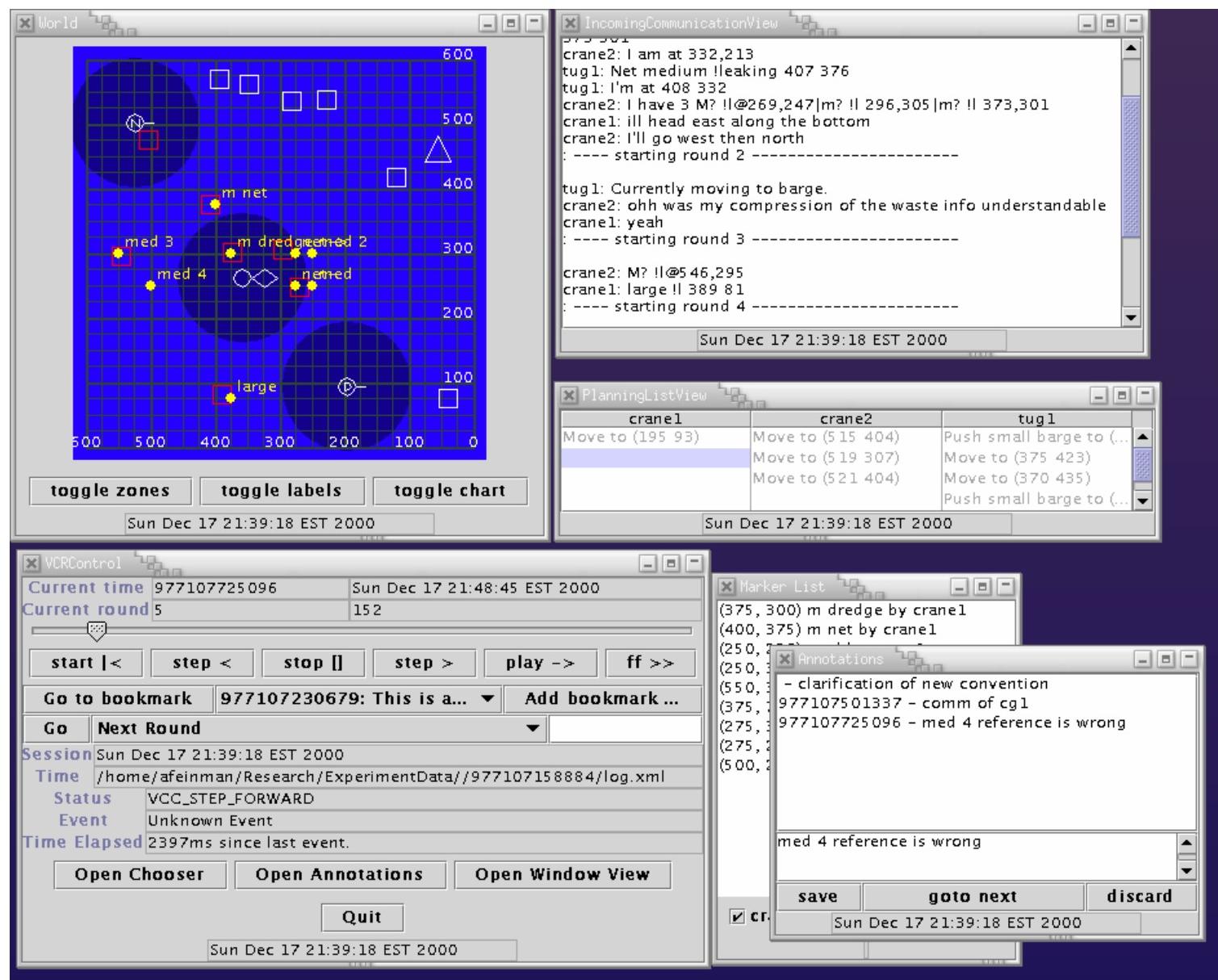
- The coordinating representation *C* is part of the vocabulary used for communicating, thinking and assessing
 - The departure/arrival monitor at the airport mediates the “pointing” between airport personnel and passengers
 - Without the departure/arrival monitor the sense the actors make of the situation, the way in which they reason about the situation, the structure of their activity is entirely different
- Continued use of *C* changes how the actors jointly construe their engagement
- Vygotsky
 - All higher level functioning begins with the social



Computational Methods

- Collecting data from online collaborations
- Cognitive Engineering
- Cognitive Modeling

Collect Data



Workforce Application

WORKFORCE SCHEDULE WORKSHEET

SCENARIO 1

Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
8 – 10 am	I	I	I		E		
10 – 12 am	I	I	I				
12 – 2 pm		F					
2 – 4 pm				F	E		
4 – 6 pm							
6 – 8 pm					E		
Employees required	3	3	5	4	6	7	4

CREATE

NOTIFICATION: other has joined.
other: hi
other: why don't you work on these days
seth: ok

Elapsed time: 0:01:12

Send

QUIT PANIC

OVAL SELECT DELETE

WORKFORCE SCHEDULE WORKSHEET

SCENARIO 1

Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
8 – 10 am						
10 – 12 am						
12 – 2 pm						
2 – 4 pm						
4 – 6 pm						
6 – 8 pm						
Employees required	3	3	5	4		

timestamp 1072205704437 position 10 / 13

Last Event: t4g.carb.SharedButtonActionCarb
Event type: No Event Filter

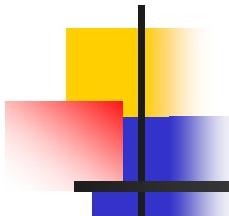
NOTIFICATION: seth has joined.
seth: hi there
other: hi
seth: you do this area
seth: are you paying attention?

Elapsed time: 0:01:35

Send

QUIT PANIC

OVAL SELECT DELETE



Cognitive Engineering

- Online practice is grounded in a representational system
- Transcripts are collected
- Identify weak spots
 - Coordination work & cognitive load
- Re-design task environment
 - Introduce new coordinating representations.
 - Leverage coordinating representations to add adaptive components.

GrewpTool

GTAS-params GREWP version 2.0, 5/1/2003

network Bnon==test.scm Anon==person.scm

File View Options

Bnon: Remember that we are just given the ankle!
Anon: OK. So I'll try to draw the foot underneath there...
Bnon: Good job. I'll fix the length of the foot, you work on the other foot.

>>

Private Browser

If you have finished part I, you may [click here to go to part II](#).

Otherwise click [here](#) to continue working on part I.

address: msets/scheme/graphics_man/ps01a.html <-- -->

(define c (canvas 500 500))
(define (part1 g)
 (.setColor g pink)
 (.fillRect g 190 460 30 20)
 (.fillRect g 160 480 60 20)
 (.setColor g pink)
 (.fillRect g 190 460 30 20)
 ;; write your code here for part 1
)

(define (part2 g) '0
 ;; write your code here for part 2
)

(define (part3 g) '0
 ;; write your code here for part 3
)

(define (part4 g) '0
 ;; write your code here for part 4
)

Public Browser Anon

Help Pages for the "Graphics: Man Problem Set"

Graphics Procedures

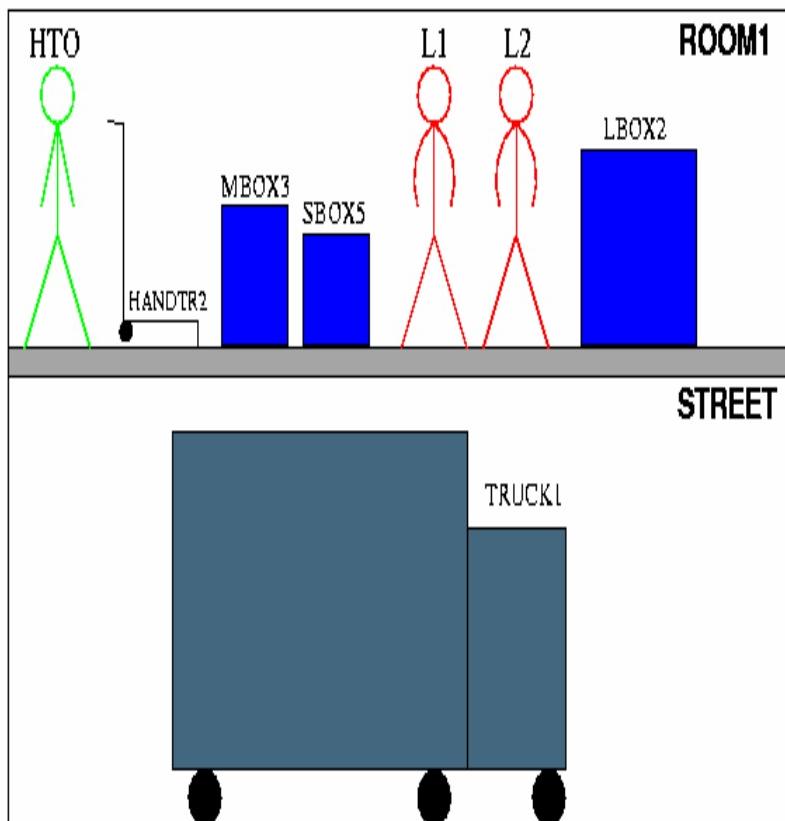
The Graphics class contains several methods for drawing onto a canvas. Before you can use them you need to understand the coordinate system used by these methods.

Coordinates

address: 090/aut02/GREWP/problemsets/scheme <-- -->

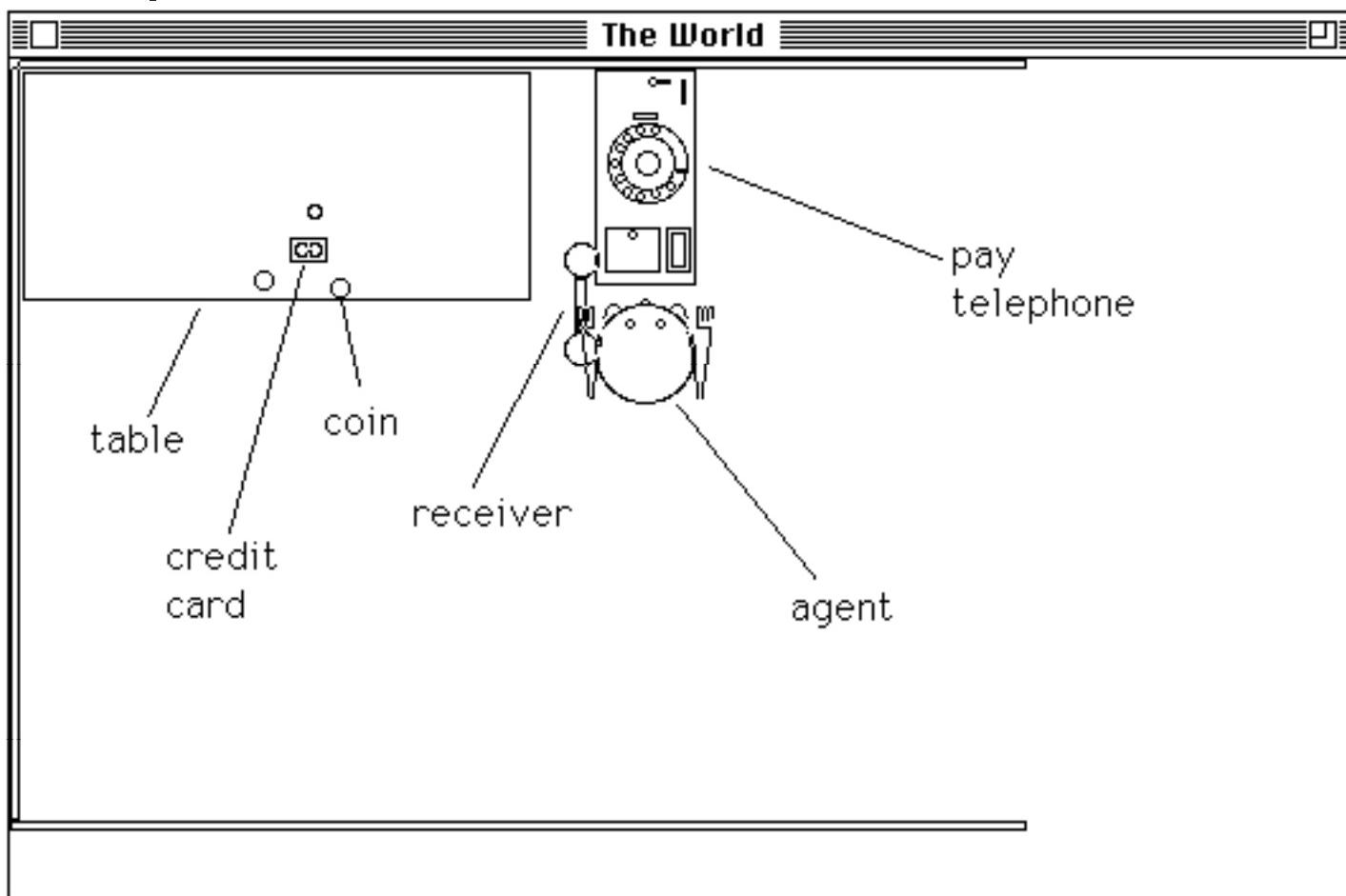
Mon Nov 24 12:04:58 EST 2003 (GREWP)--L4--C13--Total--L64--C21 PANIC edit mode eval highlight clear highlight

Cognitive Modeling

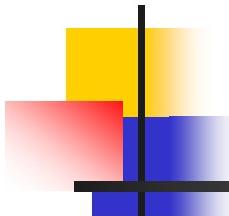


- Convention

Cognitive Modeling



- Skill Acquisition
- Adaptive Planning
- Instruction Usage



Talk Summary

- Model

- The Equivalence of Internal Representations
- Interaction and Common Ground
- Mutual Ground
- Accumulation
 - Conversational Structure
 - Coordinating Representations
 - Cycle
- Cognition